INDIAN
- MATHEMATICAL -
SOCIETY

REPORT OF THE SEVENTH CONFERENCE

TRIVANDRAM :

3RD TO 5TH APRIL 1931

THE INDIAN MATHEMATICAL SOCIETY

TRIVANDRAM SEVENTH CONFERENCE APRIL 1931.

Chairs:—1. S. Sundaram Iyer. 2. S. Venkatasubbaraau. 3. A. Weil. 4. Miss. R. [illegible]

5. Miss E. C. Agnesham. 6. V. Ramaswami Iyer. 7. **M. T. Narasiengar** (*Secretary*).

8. E. G. McAlpine. (*Chairman Reception Committee*). 9. K. S. K. Iyengar. 10. [illegible]

11. M. S. Duraiswami Iyengar. 12. K. S. Patrachari. 13. M. V. Arunachala Sastri.

Standing 1st Row:—1. V. Ramakrishna Kakkilaya. 2. S. Andhanarayanan. 3. T. Tondri Iyengar.

4. C. N. Sreenivasa Iyengar. 5. S. Ramaswami Iyer. 6. S. Venkataraman.

7. T. R. Subramaniam. 8. P. S. Ganesa Sastri. 9. P. Krishnamachari.

10. A. A. Krishnaswami Iyengar. 11. C. R. Narayana Iyer. 12. G. V. Krishnaswamy Iyengar.

13. N. Kuppuswamy Iyengar. 14. M. S. Duraiswamy Iyengar. 15. G. A. Sreenivasan.

16. A. Narasinga Rau.

2nd Row:—1. A. Ekambaram. 2. V. Ramakrishnan. 3. A. Mahadevan. 4. [illegible]

5. K. Subramanian. 6. M. V. Ramakrishnan. 7. [illegible] 8. [illegible]

9. T. S. Venkataraman. 10. T. T. Abraham. 11. [illegible] 12. [illegible]

13. C. V. Subbarama Iyer. 14. S. Tonne Iyer. 15. [illegible] 16. [illegible]

3rd Row:—1. V. S. K. Sarma. 2. P. Krishnan Nambiar. 3. [illegible] 4. [illegible]

5. M. V. Annaswami Iyengar. 6. [illegible]

THE INDIAN MATHEMATICAL SOCIETY

TRIVANDRUM SEVENTH CONFERENCE APRIL 1931.

Chair:—1. S. Sundaram Iyer. 2. R. Vaidyanathaswami. 3. A. Weil. 4. Miss. R. Gnanaprakasi,
5. Miss K. C. Annamma. 6. V. Ramaswami Iyer. 7. **M. T. Naraniengar** (*President*).
8. E. G. McAlpine. (*Chairman Reception Committee*). 9. K. S. K. Iyengar. 10. G. S. Mahajani,
11. M S. Duraiswami Iyengar. 12. K. S Patrachari. 13 M. V. Arunachala Sastri,

Standing 1st Row:—1. V. Ramakrishna Kukkilaya. 2. S Audinarayanan. 3. T. Totadri Iyengar,
4 C. N. Sreenivasa Iyengar, 5. S. Ramaswami Iyer. 6. S. Venkataraman,
7. T R. Subramaniam. 8. P. S Ganesa Sastri. 9. P. Krishnamachari.
10. A. A. Krishnaswami Iyengar. 11 G R. Narayana Iyer, 12. G. V. Krishnaswamy Iyengar,
13. N. Kuppuswamy Iyengar. 14. M R. Duraiswamy Iyengar. 15. G. A. Sreenivasan.
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2nd Row:—1. A. Ekambaram. 2. V. Ramakrishnan. 3. A. Mahadevan. 4. L. N. Subramaniam.
5. K. Subramaniam. 6. M. V. Ramakrishnan. 7. B Ramamurti. 8. S. Sivasankaranarayana Pillai.
9. T.S. Venkataraman. 10. T.T. Abraham. 11. A. Govinda Wariar. 12. R. Sreenivasan (*Local Secretary*).
13. C V Subbarama Iyer. 14. S. Thanu Iyer, 15. K. P. Krishna Menon. 16. S. Mahadeva Iyer.

3rd Row:—1. V. K K. Sarma. 2. P. Krishnan Nampoodripad. 3. P. Harihara Iyer, 4 V. Sivaraman Nair.
5. M. V. Annaswami Iyengar, 6. R. Sivaramakrishna Iyer.

SUPPLEMENT

TO

THE JOURNAL OF THE

INDIAN MATHEMATICAL SOCIETY

Volume XVIII.

REPORT

OF

THE SEVENTH CONFERENCE

OF THE

INDIAN MATHEMATICAL SOCIETY

HELD AT TRIVANDRUM IN APRIL, 1931.

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1931.

CONTENTS.

REPORT OF THE SEVENTH CONFERENCE

OF THE

INDIAN MATHEMATICAL SOCIETY,

HELD AT TRIVANDRUM, IN APRIL 1931.

The Seventh Biennial Conference of the Indian Mathematical Society was held at Trivandrum, on the 3rd, 4th and 5th of April 1931. There were about 75 delegates who had come from different parts of India to attend the Conference, most of whom were accommodated in the Collegiate Hostel. The Local Committee had made excellent arrangements for the accommodation and convenience of the delegates. The programme of visits and excursions was a varied and interesting one and was much appreciated by the visitors.

The Opening Day.

On the 3rd April, the opening function took place at 10-30 A.M. in the Jubilee Town Hall, where, in addition to the delegates, many distinguished ladies and gentlemen had assembled at the invitation of the Reception Committee.

The proceedings commenced with an Address of Welcome by the Chairman of the Reception Committee, Mr. E. G. McAlpine, M.A., Director of Public Instruction, Travancore.

The Message which was graciously sent by HER HIGHNESS THE MAHARANI REGENT was then read by the Dewan M.R.Ry. V. S. Subramania Iyer Avl., B.A., B.L., who then made a speech and declared the Conference open.

Prof. R. Srinivasan, M.A., Secretary and Treasurer of the Reception Committee, then read out messages wishing the Conference success,

This was followed by the reading of the Report of the Society by the Joint Secretary, Dr. R. Vaidyanathaswami.

Then Prof. M. T. Naraniengar, M.A., delivered the Presidential Address.

Second and Third Days.

On the second day, the members and delegates assembled for a photo at 7-30 A.M. and thereafter the papers presented to the Conference were read and discussed till 11-30 A.M. In the evening at 3 P.M., there was a public lecture by Dr. Andre Weil, Professor, Muslim University, Aligarh, on "Mathematics in Indian Universities." This was followed by a lively discussion in which several took part. At 5-30 P.M. the Members of the Reception Committee were "At Home" to the delegates in the spacious grounds of the Women's College which were tastefully decorated for the occasion.

The reading and discussion of the remaining papers were resumed on the morning of the third day and continued till 11-30 A.M. At 2 P.M. there was an informal gathering in which the members discussed certain research items which had arisen in the course of their own work. There was a Business Meeting at 3 P.M.

In the evening at 5-30 there was a public lecture by M.R.Ry. Rao Bahadur P. V. Seshu Iyer Avl., B.A., L.T., on "A Mathematical Approach to the Atman (*Soul*)" presided over by the Dewan of Travancore.

At the conclusion of the lecture, the President of the Society expressed his thanks to the authorities of the State and the Reception Committee for their hospitality and the excellence of the arrangements which were responsible for a very successful Conference.

The places of interest visited by the delegates included the local Educational Institutions, Kovallam Hills, the local Museum, the Pechipara Dam, Vattakkottai, and Cape Comorin.

The delegates had also the pleasure of enjoying some excellent instrumental and vocal music by Messrs. T. Lakshmana Pillai, the well-known poet-musician of Travancore and Dr. H. Subramania Iyer of the College of Science, Trivandrum and by Prof. R. Srinivasan, Secretary of the Reception Committee.

Welcome Address delivered by Mr. E. G. McAlpine M.A.,

Director of Public Instruction, Travancore, and Chairman of the Reception Committee.

MR. SUBRAMANIA IYER, MR. NARAYANA IYENGAR, LADIES AND GENTLEMEN :

It is my very pleasant privilege, on behalf of the Reception Committee and of all those in this State who are interested in the study of Mathematics, to welcome the Seventh Conference of the Indian Mathematical Society to Trivandrum. Yours is, I think, the first of the learned societies of India to hold a Conference here, and we trust that you may condone any deficiencies in our hospitality. If there be any such, I would assure you that they are due to our inexperience and not to any lack of good-will. Trivandrum is, perhaps, the smallest of all the towns in which you have hitherto held your Conferences, but I hope that your short stay here will convince you of the warmth of our welcome, and of our sincere desire to do everything that lies in our power for your comfort and entertainment. You have of course come here in the middle of our hot weather, and some of you may find the temperature a little trying, but we hope that the distractions of the Conference —intellectual and otherwise—may perhaps make you oblivious of mere climatic considerations. The facilities in Trivandrum may not be those that are available in large towns like Bombay or Madras, but I believe that the delegates to this Conference will take home with them memories not less pleasant than those of earlier Conferences.

It was with a certain amount of hesitation that I accepted the position of Chairman of the Reception Committee. While fully conscious of the honour that was being done to me, I could not help feeling that some one with more knowledge of mathematics than I ever possessed, and with a more intimate knowledge of its study and teaching in India, would, with greater fitness, have occupied the position. It is a regrettable confession to have to make—particularly in the presence of so many students of mathematics ; but truth compels me to say that my own knowledge of the subject has never been more than extremely scanty. When I entered Edinburgh University, there was then in existence what I regarded as a most kindly provision whereby a student taking an

Honours Degree could, if he so desired, avoid taking any class in the Science group. I have to confess that I made full use of the provision and that consequently my scanty mathematical knowledge is only what could be acquired by a school-boy who displayed, I fear, no great aptitude for the subject. My protests as to my unfitness were however lightly brushed aside by the local Honorary Secretary of the Conference, Professor Srinivasan, who assured me that a profound knowledge of mathematics was not an indispensable requisite for the Chairman of the Reception Committee. Although my own mathematical knowledge is not very extensive, I have however spent my life in educational work, and have had experience both on the teaching and on the administrative side. I am, therefore, fully conscious of the fundamental importance of your subject, particularly in an age so markedly scientific as this. Further, no one who knows anything of matters educational can be in ignorance of the value of mathematics as a mental discipline. I am personally particularly interested in the fact that your Conference is not entirely devoted to the higher and more abstruse aspects of your subject, but that you also concern yourselves with the methods of teaching mathematics. The more I see of schools, at any rate in India, the more I feel convinced that the greatest deficiency in our teachers is not so much lack of knowledge of their subjects, as ignorance of how to present that knowledge in a form suitable and interesting to the ages of the pupils.

Before I sit down, I hope I may be pardoned for introducing a personal note. It is for me a very happy coincidence that the Chairman of this year's Conference should be an old friend and colleague of my own. I have known Mr. M. T. Narayana Iyengar as long as I have been in India and for many years we were fellow Professors on the staff of the Central College in Bangalore. I have long been aware of the keen interest taken by him in the Indian Mathematical Society, and of his labours for so many years as Editor of your journal. It, is therefore, an added privilege and pleasure that I should be welcoming you here to-day in the very year in which my old friend occupies your Presidential Chair. Once again, I bid you welcome to the capital of our beautiful State of Travancore, and hope that your memories of your stay here will be of the happiest.

I now ask you, Sir, to be good enough to declare this Conference open.

Message from Her Highness the Maharani Regent of Travancore.

I feel gratified that the Indian Mathematical Society should have chosen Travancore as its venue for holding its Seventh Conference and it seems to me that it is a compliment which every one will agree the State richly deserves for the distinguished position it occupies in the educational world. The Society, with which are associated some of the noted luminaries of the day, has to its credit a fine record of achievements in the different branches of the great science to which it is dedicated, and my sincere good wishes attend its labours. While extending to the members of the Conference a hearty welcome, I trust their deliberations in Trivandrum would make some substantial contribution to the wealth of knowledge which the past activities of the Society have garnered for the benefit of the world.

Messages and Greetings

wishing the Conference success were received from

1 The Hon'ble Sir M. Krishnan Nair, Member, Governor's Council, Madras.

2 The Hon'ble Mr. H. G. Stokes, „

3 The Hon'ble Mr. A. Y. G. Campbell, „

4 The Hon'ble Mr. P. T. Rajan, Minister, Madras.

5 Sir C. V. Raman.

6 The Hon'ble Sir Sankara Rao Chitnavis, Nagpur.

7 Mr. D. D. Kapadia, Poona.

8 Mr. V. B. Naik, „

9 Mr. T. B. Hardikar, Poona.

10 Mr. V. A. Apte, „

11 Mr. M. L. Chandratreya, „

12 Mr. A. C. Banerji, Allahabad University.

13 Mr. Balasingam Satya Nadar, Madras.

14 Dr. Ganesh Prasad, Calcutta.

15 Mr. K. R. Ramaswami Aiyangar, Kumbakonam

16 Rev. D. Ferroli, Mangalore.

17 Rev. C. Pruvot, Trichinopoly.

18 Mr. K. B. Madhava, Mysore.

19 Mr. F. H. V. Gulasekharam, Ceylon.

20 Mr. Quazi Muhammad Hussain, Hyderabad.

21 Mr. P. A. Subramania Iyer, Ootacamund.

Opening Address of Mr. V. S. Subramania Iyer, B.A., B.L., Dewan of Travancore.

MR. MCALPINE, MR. NARAYANA IYENGAR, LADIES AND GENTLEMEN:

It gives me great pleasure to be associated with the Seventh Conference of the Indian Mathematical Society and I sincerely thank the Reception Committee for the honour they have done me in asking me to open the Conference.

Travancore, forming as it does the southernmost corner of India, has not in the past had that attention from scientific bodies which she considers herself entitled to. It is therefore with sincere gratitude and pleasure that Trivandrum, the capital of the State, welcomes the Conference.

My personal acquaintance with mathematics terminated with my passing out of the old F.A. class, more than 35 years ago, and I cannot in any sense claim to be a mathematician. But I am deeply interested in the work and success of the Mathematical Society, as every Indian would be; for, in its hands lies the renovation of the reputation which India once had as a pioneer in the field of mathematical research. It may not be given to every mathematician to be a Ramanujan, or a C. V. Raman; but there must certainly be many persons in India who, given the opportunity and the incentive, would be able to do useful research work and contribute materially to the advance of the science. In Travancore too, though we cannot claim to have produced any outstanding mathematical genius, our Colleges have handled a fair amount of mathematical talent. Some of it has been diverted to professions like the law where the only use evidently that it can be put to is counting rupees, annas

pies. But much of it is retained in the educational service of the State, where facilities for post-graduate work cannot be said to be altogether wanting. A body like this Society is just what is wanted to afford the opportunity and the incentive for research work that are needed to rouse the dormant talent to activity. The worker in the field of research can look to the Society for help in his work and for appreciation of good work done.

During the 23 years of its existence, the Society has done a great deal to create the scientific atmosphere in University and Educational centres in the country, that is so essential to the advancement of science. By the splendid Library which it maintains, and by the efficient Journal which it conducts, it has provided for its members the intellectual pabulum needed for their work and an efficient medium for the dissemination and discussion of new ideas and discoveries.

May the work of the Society and the Conferences it holds be fruitful in the production of eminent mathematicians in India whose work will enable modern India to take in mathematical research and achievement a place in the front rank of advanced countries!

Under the guidance of its distinguished President, who was one of the Founders of the Society and has been actively connected with it ever since, and with the co-operation of the many eminent delegates who have assembled to attend its deliberations, this Conference can be confidently trusted to have a very brilliant and successful session.

I have great pleasure in declaring this Conference open.

Secretary's Report.

The Indian Mathematical Society which was founded by M.R.Ry. V. Ramaswami Aiyer Avl., M.A., in 1907, for the advancement of mathematical study and research in India, has been steadily growing both in numbers and the scope of its activities under the guidance of its successive Presidents, Messrs. B. Hanumanta Rao, E. W. Middlemast, Prof. Wilkinson, Messrs. R. Ramachandra Rao, Balakram, V. Ramaswami Iyer, and Prof. M. T. Narayana Iyengar. Since our last Conference at Nagpur in December 1928, our membership has increased to 290, 25 new members and 2 life members having been admitted during this period.

It is with great sorrow that we have to record the irreparable loss sustained by the Society by the death of two of our most active and distinguished members, Mr. Balakram who was twice President of the Society, and was a great source of inspiration to our younger members, and our late lamented Secretary, Rai Bahadur G. S. Chowla, a self-less worker whose loss will be felt for a long time to come. We have also to mention the loss of Prof. T. P. Trivedi, an old and valued member of the Society.

Since the last Conference, the following changes have taken place in the composition of the Committee. Mr. M. T. Narayana Iyengar, under whose able guidance the journal developed during nearly two decades, is our new President, and Pandit Hemraj of Lahore, Prof. A. C. Banerji of Allahabad and Prof. G. S. Mahajani of Poona, are the new accessions to the Committee. I wish to express on behalf of the Society, our thanks to Mr. V. Ramaswami Iyer whose period of Presidentship was one of great administrative activity and reform, and who was responsible for introducing a new feature of interest in the journal by offering a prize for a solution of a by no means easy problem. I have also to express our appre-

ciation of the valuable services rendered by the retiring members, Prof. K. Ananda Rao and Mr. S. V. Ramamurti.

It is a matter of great pleasure to us that in response to an appeal for financial help, the Madras, Annamalai and Bombay Universities have generously promised annual contributions. These will ease our financial position and will enable the Society to increase the scope of the Journal.

From Nagpur to Trivandrum is a long stretch and it is a matter for congratulation for the Society that it should have been able to hold this Conference in the southern-most part of India. This has been rendered possible by the generous co-operation of the Government of Her Highness the Maharani Regent of Travancore and the enthusiasm and active interest of the Chairman and members of the Reception Committee.

Presidential Address delivered by Prof. M. T. Narayana Iyengar, M.A.

MR. DEWAN SUBRAMANIA IYER, MR. MCALPINE, LADIES AND GENTLEMEN:

By way of introduction, I crave your indulgence for a minute or two, touching the Presidential Address which is expected of me on this important occasion.

My stipulation with the former President, Mr. V. Ramaswami Iyer, before giving my consent to be proposed for the Presidentship of the Society, was that the rule about the Presidential Address at our Conference should either be suspended or modified in my case. This was not with a view to undervalue the dignity of the time-honoured practice, nor to suggest that the future Presidents should be exempted from the discharge of the exalted duty rightly imposed on the President of the Society. But it was chiefly in view of my incapacity to rise to the level of the Addresses delivered by my predecessors. I have a high estimate of your intelligence and judgment. My inability to satisfy them and consequent shyness to appear before you with a 'sham address,' full of platitudes and commonplaces, induced me to make the said stipulation. The election was however made regardless of the stipulation. You have made your choice and have to abide by the consequence of that indiscriminate choice. If therefore you should be disappointed—as I have no doubt you will be, the blame does not rest on me.

Having thus fortified myself for the shortcomings of the few observations I am going to make to-day, I shall go on, with your permission.

Since the last Conference at Nagpur, we have had to mourn the loss of three prominent members.

Mr. Balakram, I.C.S., Fourth Wrangler, was one of our Foundation Members, and was a tower of strength to the Society. The Library and the Journal owe a great deal to his liberality and

keenness of intellect. He represented Punjab and was universally loved and respected for his broad outlook, sense of justice, and enthusiasm. He was elected President twice and was on the Managing Committee almost continuously to the end. The Society has lost in him a brilliant mathematician and a warm benefactor.

Rai Bahadur G. S. Chowla, M.A., joined our Society somewhere in 1909 and took active interest in our movement all along. He was elected Joint Secretary in 1927 and continued in that capacity till June 1929, when he left for Europe to get his son S. D. Chowla admitted into Trinity College, Cambridge. After a brief illness, he died at Paris in December 1929, at a comparatively early age. He was Trustee of the Dyal Singh College, Lahore, and was a well-known and prominent personality at that place. In recognition of his services, Government conferred upon him the title of 'Rai Bahadur.'

Professor Trivedi was another active and enthusiastic member whom we have lost. He was a very frequent contributor to our Journal. His death at an early age is deplorable.

We have at the same time a pleasant duty to discharge, We convey our felicitations to Sir C. V. Raman, M.A., D.Sc., F.R.S., on his winning the Nobel Prize for 1930. He was elected an Hon. Member of our Society a few years back, in appreciation of his outstanding work in the field of Physics.

It is also matter for congratulation, though in a smaller way, that our Treasurer, Mr. S. R. Ranganathan, M.A., has been nominated as the Indian Representative on the International Library Committee by the World Association for Adult Education.

This Society was founded in 1907 for the advancement of Mathematical Study and Research in India. Let us see how far the ambitions of the organizers have been achieved during the last 24 years. Our membership list contains nearly 300 names including 9 Hon. Members, 21 Life Members and 275 Ordinary Members. An analysis of the list shows that out of these, about 60 are non-professional gentlemen; that is, gentlemen, not actively engaged in the

Teaching Profession, to whom Mathematics is more or less a recreation and a pastime. Out of the sixty, three are Hon. Members, seven are Life Members and the rest (50) are ordinary members. We find thus that no less than 240 of our Members are actively engaged in the Teaching Profession. Then, again, among the ordinary members there are members at concession rates whose number is nearly 120. This number includes mostly Tutors, Lecturers and Post-Graduate students.

It may be hazardous to draw conclusions from the above figures ; but all the same I may point out that the organizers of the Society will not be far wrong if they class the last mentioned batch of 120 concession members as coming within the scope of Research Students, while the generality of Professional Members may rank as scholars, keen in the advancement of Mathematics and devoted to the subject. I am not to be understood as undervaluing the devotion to Mathematics of the Non-Professional Members. All I mean to say is their interest cannot be exclusively *concentrated* in the subject, as other subjects have equal claim on their attention.

The Journal maintained by the Society is the principal instrument in advancing mathematical study and research. As such, the contributions to its pages and the list of contributors ought to be an index of the work done by the Society all these years. In all, we have brought out 14 single volumes and 4 double volumes. The average contributions to the former may be taken as amounting to 120 pages of '*Articles and Notes*' per volume; or, 1680 pages of printed matter in all. The average in the case of the latter is 300 pages of '*Original Papers*' and 150 of '*Short Notes*' per volume, that is, 1400 pages of matter altogether.

Thus in point of ' output ', the Journal has produced 3080 pages of substantial matter. Of course, a good portion of this may not be high-class matter ; but, the contributions in bulk aggregate to that much.

Then again, if we count up contributors, we find that the number of contributors for each volume of the first or single volume series was about 20 and that for the second or double volume series, the number rose to 40.

Classifying the contributors into (i) Professionals and (ii) Non-Professionals, their proportion is roughly 7 : 1.

These figures may not mean much and may vary from year to year, but if any value has to be attached to statistics, there they are.

I do not wish to detain you any longer with these dry and perhaps uninteresting details. Suffice it to say, that the Society may well be proud of the work done so far.

With the separation of the two Parts of the Journal into Advanced and Elementary, there has been a decided improvement in the standard of the original articles received for publication in the First Part (Advanced). It is hoped that further improvements could be effected by issuing the two parts under different titles—the first part as a Bulletin and the second part as a Journal. A resolution to the effect was adopted at the Business Meeting held in connection with the Sixth Conference at Nagpur. Nothing, however, was done. The matter requires early attention.

Next, as a necessary equipment for advanced work, a Library supplied with the most up-to-date treatises, memoirs, and periodicals is no less important. This was recognised by the Society at a very early stage and attempts were made to build up a strong Library by liberal provisions for additions year after year. Much remains to be done still in the matter of the expansion of the Library. At the Fifth Conference held at Bangalore, our energetic and enthusiastic ex-President, Mr. V. Ramaswami Iyer, made a stirring appeal to all lovers of mathematics and to the Government of His Highness the Maharajah of Mysore for donations. He said "I wish to appeal to States and Governments and all the wealthy in the land to help us to get a good Library. I appeal to them to keep the well of knowledge full for us, so that we may draw and distribute, and serve to strengthen our national life, and that we may hold the banner of mathematics aloft, as the motherland marches to glory with the rest of the world."

I can hardly improve this appeal. I reiterate it with all the strength I can command in this new land of time-honoured Charities and Gifts and trust my appeal will not go in vain.

It is my pleasant duty to acknowledge, with gratitude, on this public occasion, the help rendered to the Society by the following Universities :—

(i) The Madras University has sanctioned an annual grant of Rs. 200.

(ii) The Annamalai University :—Rs. 100.

(iii) The Bombay University :—Rs. 200.

I now propose to say something about "Research" and entreat you to hear me with indulgence. What I am going to say may not be new. In fact, my predecessor, five years ago, made some interesting remarks on the subject. If I revert to it, it is because of the importance of the subject in the first place, and next because so little has been done by our Society in the interval to give effect to his recommendations. I trust my suggestions will not share the same fate.

Now, what is Research ? Research is 'Investigation', in one word. This investigation may be laborious and protracted seeking of facts, principles, or truths in a majority of cases ; or, it may be simply intuitive and spontaneous, in exceptional cases.

In the former case, it may assume the form of deep penetration into the historic past and be labelled 'historic research,' or, it may mean the discovery of hidden secrets of nature, when it is experimental ; it may be a close and continuous study of symbols, figures and forms, when it is mathematical ; it may mean the unfolding of the inner thoughts of a seer or thinker, when philosophical ; or, it may be the interpretation of the mind of a poet or an artist when literary and æsthetic. It may even mean a collection of data after careful examination, and study ; and their co-ordination and formulation.

When intuitive and spontaneous, it is the work of genius and is the creation of a moment. It is 'inspired' and 'flashes' to the mind. As an instance, I may refer to the work of the late Ramanujan, F.R.S. Just as poets sing their songs by inspiration and artists produce their master-pieces spontaneously, a man of genius discovers facts and beauties intuitively, without plodding, without labour. To him truth reveals itself, he does not go in search of it.

Confining ourselves, for the time being, to the first class who are not born geniuses, we shall examine the best method of promoting research in mathematics so far as our Society is concerned. The very fact that as many as 120 lecturers, tutors and graduates have joined the Society at concession rates indicates a desire on their part to devote themselves to research work. We may, therefore, presume that most of these are well-equipped for such work and have gone through the necessary preliminary studies. The question now is : Can our Society give them help to organise themselves and to direct their energies into regulated channels, so that there may be tangible results ? It is well-known that modern Universities invariably lay stress on Research, and a Department of Research has come to be associated with each university-centre to-day as an indispensable adjunct. Universities, however, can only be expected to stimulate research in 'stray' cases coming within their jurisdiction ; and consequently, their activities in the field should be regarded as parochial and narrow from our point of view. Our Society, on the other hand, has a broader outlook and is an 'All India' Society. It thus behoves us to tackle the question in the right spirit and arrive at a solution.

To me it looks as if the times are propitious for a beginning. We have, fortunately, as our Joint Secretary and Editor, a Doctor of decided abilities, who is at the same time the Reader in Mathematics at the Madras University. As a Researcher in Mathematics, his reputation is fast spreading. In his dual capacity as Editor of our Journal and Reader for the University, he comes in contact almost daily with most of our junior members either personally or by correspondence. Our Joint Editor is Reader in Mathematics in a sister University and is equally distinguished. Further, at our Headquarters (Poona) we have a band of enthusiastic staff and students in the Fergusson College, whose devotion to learning and to the country is a matter of tradition and pride. Principal Mahajani is the moving spirit of that institution and his lead in formulating any new scheme is assured. These and our worthy collaborators will be the fittest persons to give the requisite impetus to research. My suggestion to them is that they should enlist the co-operation of a few other prominent scholars representative of the various Indian Universities

and open a Department of Research in close connection with our Journal. Their task will be to guide the junior members of the Society and set them on the right track. A special column should be reserved in the Journal for their benefit. In this column, topics of interest to research students should be systematically dealt with; summaries of the most recent advances in mathematical science may from time to time find a place in the column, so as to direct attention to subjects that are engaging the minds of eminent men in other countries. Occasional correspondence regarding questions of general interest can also be admitted into the section. Once the idea is accepted, a number of useful topics will suggest themselves to the organisers and I have no doubt, their pains will be amply rewarded.

In this connection, I am pleased to note that our Editor, Dr. Vaidyanathaswamy, has of his own accord taken the initiative and has helped many a beginner in bringing his work to shape by suggestive timely hints and otherwise. What I am now pleading for is an organization whereby such help could be rendered on a more extensive scale and more systematically. If the Editors take up my suggestion in earnest and work with a little zeal, it will not be difficult for them to show rapid progress.

As an example of what the close association of juniors with eminent scholars in the early stages is likely to achieve, I may be permitted to quote from an obituary notice of Archibald Smith, Senior Wrangler and Smith's Prizeman :—

"After completing his fourth session in Glasgow, he joined a reading party under Hopkins. While still an undergraduate, he wrote and communicated to the Cambridge Philosophical Society a paper on Wave-surface. The mathematical tact and power for which he afterwards became celebrated were shown to a remarkable degree in this his first published work. The discoverer of the theory, had determined analytically the principal sections of the wave-surface, and then guessed its algebraic equations. This he had verified, by calculating from it the perpendicular from the centre to the tangent planes, but the demonstration thus obtained was so long that he suppressed it in the published paper. Ampere by sheer labour had worked out a direct analytical demonstration occupying 32 pages

which presented so repulsive an aspect that few mathematicians would be pleased to face the task of going through it. With these antecedents, Archibald Smith's investigation, bringing out the desired result directly from the postulates by a few short lines of beautifully symmetrical algebraic geometry, constitutes no small contribution to the elementary mathematics of the undulatory theory of light. It was one of the first applications in England, and it remains to this day a model example, of the symmetrical method of treating analytical geometry."

"Shortly after taking his degree, he proposed to his friend Gregory of the celebrated Edinburgh Mathematical family, then an undergraduate of Trinity College, the establishment of an English periodical for the publication of short papers on mathematical subjects." Gregory cordially entered into the scheme and the result was the 'Cambridge Mathematical Journal,' of which the first number appeared in November 1837. This was carried on under various Editors and with several changes of name—as the 'Quarterly Journal of Mathematics,' 'the Messenger of Mathematics,' etc., until recent times. This original 'Cambridge Mathematical Journal' of Smith and Gregory attracted to it able contributors among whom were Donkin, Walton, Sylvester, Ellis, Cayley, Boole—, and inaugurated a most fruitful revival of mathematics in England, of which Herschel, Peacock, Babbage and Green had been the prophets and precursors."

Another practical mode of encouraging Research is by means of "*Prizes and Endowments*" for original contributions in speciai branches of mathematics. Here again, Universities have a distinct duty. What our Society can do and ought to do is to create public opinion in favour of founding such Prizes and Endowments. Private benefactions from Maharajahs, Rajas, and Zemindars should be canvassed and pooled together, so as to form the nucleus of a '*Fund for the Advancement of Research.*'

Though our Society resolved at two successive Conferences that a *Ramanujan Memorial Prize* should be instituted, nothing could be done in that connection for want of funds. We are glad to note however that a Prize called 'The Ramanujan Memorial Prize' has

been recently established in the Madras University at the instance of the late Ramanujan's friends and admirers. In this connection, the example of Sir Asutosh Mookerji of Bengal is unrivalled and can only be cited as an ideal. Besides creating a Council of post-graduate studies in the University of Calcutta for the promotion of Research, he made several endowments in memory of his father, mother, and other relatives for the encouragement of advanced studies in various departments of learning. His enthusiasm and munificence knew no bounds.

Let us appeal to the wealthy classes to help us in the creation of a '*Fund for Mathematical Research*' and place our trust in their Charity.

A quicker and more immediate—though less certain and perhaps less dignified—method seems to be to lend our journal for the advertisement of "*Competition Mathematical Essays*" on the lottery system, competitors for an Essay being asked to deposit a small sum.

A third way in which we could create an interest in advanced mathematical studies is by introducing reforms in the teaching of mathematics in schools and colleges. The aversion which one finds in schools and colleges for mathematical science is largely due to the way in which the subject is taught in the early stages. Given the right class of teachers, there is no reason why our subject should not be as popular and pleasant as any other subject. The teacher should create in the taught a desire to know the 'why' and 'wherefore' of a thing and should not be content with merely solving questions of a stereo-typed fashion. The pupil must be made to take a delight in solving problems involving principles of mathematics, by occasional stories of the *discoveries* of great men, and explaining how each such problem attacked in the right spirit marks a real *discovery*. Mathematical *Clubs and Associations* and mathematical *Laboratories* are accessories in this direction whose value cannot be overestimated.

As an experiment, colleges may recommend books for supplementary reading dealing with mathematical subjects of a general character, such as : biographies of mathematicians, history of mathematics, mathematical recreations. Every student should be encour-

aged to submit a report or review of the books read and credit should be given for such extra reading. At the end of the course, he will have thus the accumulated account of the extra-work done during the whole term to his credit.

The first taste for things literary and scientific is formed in schools and colleges, and is often crude and immature. The influence of good books and healthy environments is therefore an indispensable corrective. To some, the memory of University days perhaps conjures up the horrors of examinations and the ghost of an examiner. But a majority, I am sure, find comfort in the thought that the habits of school days persist through life and lessons irksome in the early days redound to their credit in after life.

On an occasion like the present, it is not unusual to place before the meeting a brief summary of recent advances in mathematical science and the activities of scholars engaged in mathematical research. To this end, I got prepared a set of 'Notes' under two main heads :—

(i) '*Developments*' in mathematics, and '*Contributions*' to journals, etc., by specialists, and (ii) '*Outstanding Events*' of interest to the mathematician.

The detailed 'Notes' run to many pages of matter and are sure to tire the present audience. They will be at the disposal of the Editors of our Journal, if they care to have them in connection with the proposed '*Research Column.*'

I shall confine myself now to a few significant remarks culled out of these notes.

1. Developments and Contributions

(1) *Geometry.* Recent developments of this subject have been mainly influenced by Physical Theories, such as the Theory of Relativity. The geometry of hyper- space is receiving increased attention as a consequence, '*Non-Reimannian Geometry*' as developed by Eisenhart in his book on the subject being an instance in point.

Classical Differential Geometry and Projective Geometry have also some remarkable results to their credit.

The applications 'θ *functions*' to the geometry of curves and surfaces, connection between Modular Geometry and Group Theory, etc., are some remarkable examples of the unity of diverse branches of mathematics.

(2) *Algebra.* Dickson's *Algebras and their arithmetics* (1924) is a contribution to the subject of linear algebras. The numerous new theorems in the Theory of Invariants and extensions of old theorems go to prove that some new discovery akin to logarithms may be anticipated in the near future.

(3) *Trigonometry.* There is a tremendous literature on the subject of trigonometric series, which keeps on growing with years. Developments with the aid of Fourier Series play an important part in every department of mathematics and physics, and it is not easy to over-estimate the value of the contributions in the subject.

(4) *Theory of Numbers.* This subject which has all along been a favourite theme of research by leading mathematicians and thousands of amateurs still continue to hold the field and the greatest interest centres round it. The tendency in modern times has been to restore to their proper position certain fruitful concepts of Gaussian tradition which were neglected for over a century. Of these may be noted, in particular, the idoneal numbers of Euler, the return to general rational integer co-efficient in binary quadratic forms as advocated by Kronecker, and the restoration of pre-Gaussian diophantine analysis to its place of prominence. Recent developments are indicated below :—

(i) Proof of the converse of Fermat's Theorem.

(ii) Kempners' Theory of Residual Polynomials and Congruences (1921).

(iii) The famous equation $ax^2 + by^2 + cz^2 = 0$, and the researches of Ramanujan and Dickson on *universal forms* (*i.e.*, representing all integers) and *regular forms* (*i.e.*, universal, except as to integers in certain arithmetic progressions).

(iv) The problem of lower bounds of the absolute values of numbers represented by an infinitude of binary quadratic forms.

(v) The crown of modern work is the brilliant achievement in the "Analytical Theory of Numbers" at the hands of Ramanujan, Hardy, Littlewood and others.

(vi) Perhaps, the most remarkable result of the Analytical Theory is what is known as '*Thue's Theorem*,' after the name of the discoverer Axel Thue. It might be safely said that arithmetic (since the days of Gauss) has few results to offer that are so completely general and satisfactory as this theorem.

The Theorem is :—

(A) Let $f(z) = (a_n z^n + \ldots a_0)$ be an irreducible polynomial of degree $n \geqslant 3$, with integral co-efficients. Consider the corresponding homogeneous polynomial

$$H(x, y) \equiv (a_n x^n + a_{n-1} x^{n-1} y + \ldots a_0 y^n)$$

If c is an integer, $H(x, y) = c$ has either no solution, or only a finite number of solution in integers.

(B) The above theorem holds also if we omit the assumption that $f(z)$ is irreducible, but assume that all its roots are distinct and $c \neq 0$.

(5) *Finite Differences and Difference Equations.*

The revolt against formalism which has come with the Function Theory has tended to relegate 'Finite Difference' into the background. The methods of development by factorial series and the method of successive approximations are two fashionable methods in the treatment of the subject.

In the case of "Difference Equation," the treatment by Contour Integrals and by Gamma Functions has placed the subject on a new basis altogether.

(6) *Integral Equations and Calculus of Variations.*

The latest developments of the former up to 1928 are dealt with in the book of Hellinger and Toeplitz.

The latter, which in its classical period depended for many of its pivotal theorems on the theory of Differential Equations, now employs the theory of Integral Equations extensively.

(7) *Functions of Several Complex Variables.*

Osgood's books of 1924 are the latest authority still on the subject.

(8) *Mathematical Logic.*

Since the publications of Whitehead and Russel's *Principia*, the followiug developments have taken place :—

(i) Whitehead and Russel tried to escape the contradictions in the Theory of Aggregate by means of their "Theory of Types"; but this theory when applied in other fields produced self-contradictory results, (*e.g.* ordinary analysis).

(ii) Whitehead and Russel tried to avoid this difficulty by introducing the Axiom of Reducibility.

(iii) Weyl pointed out in 1918, that the Axiom of Reducibility was not really self-evident, rejected the axiom and accepted the consequence that ordinary analysis was wrong.

(iv) Since then, Weyl has changed his view and become a follower of the Intuitionist School, whose chief doctrine is the denial of the "*Law of the Excluded Middle*," *viz* :—"Every proposition is either true or false.

(v) The system of Hilbert is designed to put an end to such scepticism and consists in regarding higher mathematics as the manipulation of meaningless symbols according to fixed rules. Besides, Hilbert postulates another subject called *meta-mathematics* which is not meaningless, and which consists of real assertions about mathematics. The most important theorem of *meta-mathematics* is that it is not possible to deduce a contradiction from the axioms.

(vi) There has of late been a growing dissatisfaction with the above views and Wittgenstein has put forward a theory of what are called atomic propositions, which provides a simple account of existential and general propositions. This theory also explains precisely the peculiar nature of logical propositions by showing that they are all tautologies, except the axiom of reducibility, and the consequential *philosophical* objections.

(9) *History of Mathematics.*

The publication of the Rhind Mathematical Papyrus in two volumes during 1927, 1929 is an event of great importance in connection with the history of mathematics. The publication is the outcome of 20 years' work.

Cajori's recent book (1929) on the History of Mathematical Notations (in two volumes) is also a valuable record.

(10) *Applied Mathematics.*

The tendency now-a-days is to attach great significance to the structure of a subject and its aesthetic worth. From these points of view, Dynamics has acquired greater value than either Projective Geometry or Theory of Groups. The methods of determining qualitatively all possible types of motions and the inter-relations of these motions have been developed recently by Birkhoff from the standpoint of the Theory of Set of Points giving rise to what are called " wandering " and " non-wandering " motions, " central " motions,, " recurrence " etc.

The theory of surface transformations is freely used in modern dynamics. The famous solution of Sundman of the " problem of three bodies " goes to prove that dynamics is becoming more and more a part of pure mathematics.

Again, Engineering Mathematics recognises likewise the importance of analytical methods in solving engineering problems, combined, of course, with laboratory experiments. As instances, we may cite :—

Mohr's circle for combined stresses, conjugate beams for obtaining deflection, tangent property of ellipse of inertia for determining central axis, the use of integral methods, etc, etc. The application of the theory of continued fractions in designing electric net-works is another interesting and novel feature of the use of mathematics.

(11) *Astronomy and Astro-Physics* :—

The present age is truly an age of spectra both in physics and astro-physics. Band-spectra, Line-spectra, X-ray spectra, these are the phenomena which have laid bare the structure of the molecule and atom. The presence of the so-called "*absorption lines*" in a stellar spectrum is proved to be the "*net balance*" of the import and export of energy at the boundary surfaces of stellar atmosphere. Until recently, astro-physicists were content to measure simply the positions of the "*line-contours*." Now they are concerned with the more difficult problem of the measurement of their intensities. Complete analysis of line-contours in stars will ultimately provide the absolute value of the capacity of stellar material at the surface and the number of atoms of each species of element per cubic cm. at various depths. Spectro-photometric measurements are destined to produce evidence concerning masses of stars. The mass of a star decreases with its age, since the outflowing radiation carries away mass ; hence the difference in mass between two stars is a measure of the difference in their ages.

One of the major results of "Pure Astronomy" in recent years is the discovery of the rotation of our "*galaxy*" as a whole.

"Astro-physics is a science with the charm of youth. It is however, not a 'self-centred' science. To Astronomy, it is gradually contributing new lines of attack on the problems of cosmical evolution. To physics, it has contributed valuable knowledge. To applied mathematics, it has contributed the concept of "radiative equilibrium." It has set for pure mathematicians new problems involving the solution of Integral Equations now under investigation by leading mathematicians. To general science, it has contributed justification of the hypothesis of the uniformity of Nature. It has proved that the *Laws of Matter*,

of Radiation, and of Thermo-dynamics hold with equal accuracy in the vastness of cosmic space. Astrophysics, the youngest of the sciences, can look forward to a life longer than any of the older sciences, for, its field is unlimited as the cosmos itself."

II. Outstanding Events.

(i) The International Congress of Mathematicians met at Bologna in September 1928. Some 800 members attended the Congress and the number of papers contributed was 400.

(ii) Dr. Glaisher died on 7th December 1928 at the ripe age of 80.

(iii) Major MacMahon died on 25th December 1929 at the age of 75.

(iv) Prof. Gibson died on 1st April 1930 at the age of 71.

(v) Prof. Cajori died on 14th August 1930.

(vi) Mr.Greenstreet died on 28th June 1930 at the age of 69.

(vii) Dr. H. H. Turner died on 20th August 1930 at the age of 69.

(viii) A Mathematical Institute was built at Göttingen, which was the ideal of F. Klein, through the generous gift of the Rockfeller Foundation.

(ix) The Royal Society of Edinburgh awarded the *Gunning Victoria Jubilee Prize* for 1924 to Prof. E. T. Whittaker for his mathematical work.

(x) Prof. Littlewood was awarded the Royal Medal of the Royal Society in 1929 for his mathematical work.

(xi) Dr. Bromwich died in 1929.

(xii) Sir C. V. Raman was awarded the Medal of the Italian Royal Society in 1930; also, the Hughes Medal of the Royal Society for 1930 and the Nobel Prize for Physics for 1930.

(xiii) M. Paul Appell of the University of Paris died in 1930.

(xiv) The Quarterly Journal of Mathematics which had ceased to exist for some years revived under a group of distinguished mathematicians, including Prof. Hardy, in 1930.

(xv) Discovery at the Lowell Observatory of a new Trans-Neptunian Planet (Pluto). The elements of this planet are given in I.A.U. Circular No. 271. :—

(1) Eccentricity ·909 ; (2) Semi-major axis 217 ; (3) Perihelion-distance 19·64 units ; (4) time of Perihelion 1900·5. (5) Inclination of Orbit 17° 21′ ; (6) Longitude of Perihelion 12° 52′ ; (7) Ascending node 109° 21′ ; (8) Period 319 years ; (9) Distance from Sun 41·3 units.

Harvard Observatory gives, however, the following :—

Eccentricity	·25	On the basis of
Perihelion date	1988	Mt. Wilson Observatory.
Period	252 years.	

We have said before that research is quest after truth. Scientific truth is universal and knows no geographical limitations. It is one for the whole civilized world.

Speaking of other forms of truth, we may ask :—Is there a reason for everything ? The child in its curiosity asks a similar question and accepts any fantastic explanation, instead of none. So also the grown-up man has to content himself with any reason to none, with regard to many things that are mysterious or inscrutable.

All truths converge in God, as the Highest Truth. We shall appropriately conclude by referring, however briefly, to this highest truth.

The " Scepticism " or " Agnosticism " in matters religious of the past century was the result of ' over-confidence ' or ' dogmatism ' on the part of the theologian, perhaps. In this century, however, this scepticism is spreading to science itself. Science teachers to-day are not aware of their foundations and cannot be dogmatic about them. There can be nothing like '*absolute truth*' from a physicist's point

of view and all knowledge is '*relative*'. The sciences are thus all based on 'hypotheses' which are mere 'probabilities'.

In his Inaugural Address to the Students of the University of Glasgow, Gladstone defended the Christian Religion against the Scepticism of his age thus :—

"No defence is to be found in timidity, but much defence is to be found in circumspection. What we have most to complain of is a precipitate rapidity of question, trial and summary condemnation. There is a kind of steeple-chase philosophy in vogue. Sometimes knowledge of external nature is thought to convey a supreme capacity for judging questions which belong entirely to the sphere of moral action and of moral needs.

"If we are taught that it is vain to think of knowing God since such a conception is beyond our grasp, inquire of the teachers how much there is of our knowledge which is more than an account of probabilities, and whether if we will accept nothing as knowledge but what is absolute and perfect, we shall not bring the catalogue of what we know dangerously near to zero."

It is easy to demolish but difficult to construct. 'Art' is laborious and long in achievement, its destruction however is simple. If the old sanctioned and organised religion is abandoned, what is there to replace it. Science, by itself, has no power to appeal to our moral and emotional needs. Just as the beautiful in nature, or external beauty, appeals to the scientific mind, the beautiful in soul or internal beauty appeals to the spiritual mind. There can be no conflict between the two. The outer world and the inner world are complementary and form one integral whole.

According to the great poet, Dr. Rabindranath Tagore, Science is concerned with that which is not confined to individuals. It is the impersonal world of truths. Religion realizes these truths and links them up with our deeper needs. Our individual consciousness of truth gains universal significance. Religion applies values to truths and we know truth as 'God', through our own harmony with it."

Professor Einstein defines 'Cosmic Religion' in the following terms:—

"The individual feels the vanity of human desires and aims; and the nobility and marvellous order which are revealed in nature and in the world of thought. He feels the individual destiny as an imprisonment and seeks to experience the totality of existence as a unity full of significance. This is Cosmic Religion. How can this cosmic religious experience, be communicated from man to man, if it cannot lead to a definite conception of God, or to a Theology? The most important function of art and of science is to arouse and keep alive this feeling in those who are receptive."

Knowing our limitations and our ignorance, we would be wise if we strove to expand our understanding, as a necessary preparation for the realisation of truth. This can only be done by 'discipline' and 'study'. But these alone are not enough. For any great achievement, genius or intuition is also needed. Just as man's intellectual, moral and spiritual faculties are the gifts of God, intuition is also a gift of God. Science, art and religion require these gifts in abundance.

Dr. Rabindranath Tagore, as a true Advaitin, thinks that there can be no Reality outside the human mind and that the Universe is relative and not absolute. Professor Einstein, on the contrary, is convinced—though he cannot prove the validity of his theory—that the Universe is a Reality apart from the human mind.

I, as a follower of Ramanuja, take my stand on the Visishtadvaita doctrine, which asserts that the Universe is Real and not relative and is in agreement with Prof. Einstein's theory. I may be permitted to sum up in a few words this doctrine.

(1) The Universe comprises three fundamental '*Entities*' or '*Tattvas*,' viz:—Chit, Achit, and Paramatma; that is, soul, matter, and God. These three always exist in triple combination. The first two are attributes (Viseshanas) of the third (Visishta). Hence the term *Visishtadvaita.*

(2) There is not a cell, particle, or atom, but is permeated and sustained by God. The manifestations of the world (or the

phenomena of nature), are the result of grades of combination of the above-mentioned tattvas. In other words, the subtle, or '*sukshma-chidachidvisishta-Brahma*' manifests itself in the form of the world, or '*sthula-chidachidvisishta-Brahma*'.

In conclusion, God as the Highest Truth is the fountain-head of all sciences. The end and aim of Research should be to bring us nearer to God, that is, to Nature. In so far as we succeed in this attempt to approach God, we are orthodox and religious. This is true religion and true devotion. Mathematics, with its conceptions of infinities, imaginaries and higher dimensions is peculiarly fitted to help us to become truly orthodox and religious.

May our Society be the means of removing scepticism and developing truth, piety and diligence !

Before resuming my seat, let me thank you most heartily for the patience with which you have heard me.

The Society is deeply indebted to the Government of Travancore for the liberal grant towards the expenses of the Conference and to Her Highness the Maharani Regent for her Gracious Message. Its thanks are also due to the Dewan, M. R. Ry. V. S. Subramania Iyer Avl., B.A., B.L., for kindly opening the Conference and otherwise sympathising with our movement. Our obligations to the Director of Public Instruction, Mr. E. G. McAlpine, deserve special mention. But for his initiative and support throughout, the holding of our Conference here would not have been possible.

Papers and Communications

(1) Professor A. WEIL (Aligarh): ***A theorem on curves on a ring-shaped surface.***

(2) V. RAMASWAMY AYYAR (Chittoor): ***On pencils of θ-pedal triads on a conic.***

It is shown that the θ-pedal triads on a conic can be arranged (after Dr. Vaidyanathaswamy's manner for pedal triads) in two families of pencils such that each θ pedal triad belongs to one pencil of each family.

(3) R. VAIDYANATHASWAMY (Madras): ***On Monotone Functionals.***

It is sought here to obtain a generalised statement of the usual properties associated with the continuity of a function f defined in an interval, say (0, 1) by means of the concept of monotone functional $F(f, I)$. A functional $F(f, I)$ associates with each sub-interval I a number $F(f, I)$ depending on the values of f at all points of I. The functional F is *monotone* if, either $F(f, I) > F(f, I')$, or $F(f, I) \leq F(f, I')$, for every pair of sub-intervals I, I', such that I contains I'.

(4) ——— : ***Pedal curves on the Quadric Surface.***

The pedal curve of a quadric surface Q with respect to a linear line complex L is the quartic curve on Q the normals at which belong to L. These pedal curves possess general properties similar to those of pedal tetrads on a conic.

(5) A. NARASINGA RAO and B. RAMAMURTHI (Chidambaram): ***On a certain metrical invariant associated with four co-planar points.***

Among the conics through four given points in a plane is a unique one of minimum eccentricity. The θ-normals at the four points to this conic are concurrent for some value of θ. The invariant studied in the paper is the angle θ.

(6) K. SATYANARAYANA (Rajahmundry): ***A proof of the pole and polar property of the general conic.***

This gives an alternative proof of the fundamental property, valid for all the species of conics.

(7) K. SATYANARAYANA (Rajahmundry): ***Some properties of a certain family of conics with a common focus.***

When the family has a common self-polar triangle, it is proved that it contains (1) two conics with eccentricity e, provided $e >$ a certain value e_0, (2) a parabola and (3) a conic with eccentricity e_0. Also, the directrix of the parabola is the circumdiameter of the triangle through the pole of the focal line, the directrix of the limiting conic is a bisector of the angle at the pole of the focal line, and the directrices form an involution-pencil.

(8) S. SIVASANKARANARAYANA PILLAI (Chidambaram): *On Numbers analogous to the Highly Composite Numbers of Ramanujan.*

Three classes of numbers are defined, (1) Highly Composite numbers of the tth order, namely numbers N such that $d_t(N) > d_t(N')$ for all $N' < N$, (2) Highly Abundant numbers of the rth order, namely those for which $\sigma_{-r}(N) > \sigma_{-r}(N')$ for all $N' < N$, and (3) Totient numbers or those for which $\phi(N) < \phi(N')$ for all $N' > N$. The structure of these numbers is partially determined, and their inter relation is considered. The author suspects that a highly abundant number of the rth order is necessarily one of any lower order, but has no proof.

(9) ———: *On a Statement of Ramanujan.*

In one of his letters to Hardy, Ramanujan states that "the number of numbers of the form $2^p 3^q$ less than n, is"

$$\frac{\log(2n)\log(3n)}{2\log 2\log 3}."$$

The paper establishes a generalisation of this result.

(10) ———: *A generalisation of a theorem of Wolstenholme.*

Wolstenholme's theorem that

$$1 + \frac{1}{2} + \ldots + \frac{1}{p-1} = 0 \pmod{p^2}$$

for a prime $p > 3$, has been generalised by Mr. Chowla into:

$$\sum \frac{1}{a} = 0 \pmod{p^{2m}},$$

summed for a's such that $a \leqq p^m$, $(a, p) = 1$. In this paper the following further generalisation is proved:

$$12 \sum \frac{1}{a} = 0 \pmod{n^2};\ a \leqq n,\ (a, n) = 1.$$

(11) B. RAMAMURTHI (Chidambaram): *Some Constructions in the Gauss plane.*

Constructions are obtained, (1) for finding a pair of points on a given circle harmonically separating two given points, (2) for finding a point pair with a given midpoint, harmonically separating a given point-pair,

(12) B. RAMAMURTHI (Chidambaram): ***A contribution to the Inversion-Geometry of the bicircular quartic.***

Every bicircular quartic (or *cyclic*) is self-inversive with respect to four mutually orthogonal circles, namely, the director circles. The cyclic contains an infinity of tetrads of the syzygatic pencil determined by the director circles. The paper studies the circumstances under which the parameters of these tetrads correspond to the points of a circle in the Gauss plane.

(13) M. BHIMASENA RAO (Bangalore): ***The double foci of curves in Morley's theorem.***

Starting with the expressions for the co-ordinates of the 9th common point of intersection of cubics through the vertices of the triangle of reference, and cutting the sides of the triangle in points lying on

$$\frac{\alpha}{p} + \frac{\beta}{q} + \frac{\gamma}{r} = 0,$$

and passing through two other points, obtained in the paper on "Envelopes of Cubics" by the author in the Half-Yearly *Mysore University Journal*, Vol. II No. 1, (January, 1928), it is shown that, if curves of class three touch the 6 joins of 4 points and have double contact with a given conic, the tangents at the points of contact intersect on the sextic,

$$\begin{vmatrix} \alpha^2\,\alpha'^2 & \beta^2\,\beta'^2 & \gamma^2\,\gamma'^2 \\ \alpha^2 + u\alpha'^2 & \beta^2 + v\beta'^2 & \gamma^2 + w\gamma'^2 \\ u & v & w \end{vmatrix} = 0,$$

where the tangential equation of the given conic is

$$u\xi^2 + v\eta^2 + w\zeta^2 + 2u'\eta\zeta + 2v'\zeta\xi + 2w'\xi\eta = 0.$$

From this, it follows that the double foci of curves in Morley's Theorem lie on

$$\begin{vmatrix} \alpha^2\,\alpha'^2 & \beta^2\,\beta'^2 & \gamma^2\,\gamma'^2 \\ \alpha^2 + \alpha'^2 & \beta^2 + \beta'^2 & \gamma^2 + \gamma'^2 \\ 1 & 1 & 1 \end{vmatrix} = 0,$$

where α', β', γ' now represent the perpendiculars from a point on the altitudes of the triangle of reference. It is further shown that if P (l, m, n, l', m', n') be the double focus of a curve in Morley's Theorem, r_1, r_2, r_3, r_4 being the distances of P from the orthocentric system of points A, B, C, H, then the perpendiculars, from A, B, C, H, on the common tangent of the Nine Points Circle and the curve are proportional to

$$\frac{lr_1^2}{l'}, \frac{mr_2^2}{m'}, \frac{nr_3^2}{n'}, \text{ and } \frac{l_n\, nr_\mu^2}{l'm'n'}.$$

(14) M. BHIMASENA RAO and M. VENKATARAMA IYER (Bangalore):

Following the method of Lachlan, the absolute of the Ex- and In-circles of a triangle ABC is reduced to the form

$$\frac{x^2}{r_1^2}\{r_1^2+(s-a)^2\}+\frac{y^2}{r_2^2}\{r_2^2+(s-b)^2\}+\frac{z^2}{r_3^2}\{r_3^2+(s-c)^2\}+\frac{w^2}{r^2}\{r^2+s^2\}-2bc\left\{\frac{yz}{r_2r_3}+\frac{xw}{r_1r}\right\}-2ca\left\{\frac{zx}{r_3r_1}+\frac{yw}{r_2r}\right\}-2ab\left\{\frac{xy}{r_1r_2}+\frac{z_1w}{r_3r}\right\}=0.$$

where x, y, z, w are the powers of any point with respect to the ex- and in-circles The non-homogeneous relation between x, y, z and w takes the simple form

$$\frac{x}{r_1}+\frac{y}{r_2}+\frac{z}{r_3}-\frac{w}{r}=4R,$$

so that the equation of the line at infinity is

$$\frac{x}{r_1}+\frac{y}{r_2}+\frac{z}{r_3}-\frac{w}{r}=0.$$

Using these tetracyclic co-ordinates, the equations of related circles and lines are obtained.

(15) Professor K. S. K. IYENGAR (Bangalore): ***A system of linear equations in an infinite number of variables, and its relation to some theorems on differences of non-integral order, and an associated integral equation.***

(16) K. VENKATACHALA IYENGAR (Bangalore): *On Weierstass' non-differentiable function.*

The best condition that has been given hitherto for the non-differentiability of

$$f(x)=\sum_0^\infty a^n\cos b^n\pi x$$

is, $ab>1+\frac{3\pi}{2}(1-a)$ where $0<a<1$ and b is odd, due to Bromwhich. The case of b even is mentioned by Hardy in T. A. M. S. (1916), where he gives a condition given by Dini. In this paper better conditions are found for these cases, as well as the case of Cellerier's function

$$\sum_0^\infty a^n\sin b^n\pi x,$$

(17) C. N. SREENIVASIENGAR (Bangalore). *A theorem concerning the p-discriminant.*

The following theorem is believed to be new: The necessary conditions (not always sufficient) that the differential equation $\phi(x, y, p) = 0$ (ϕ being a polynomial) should admit of an envelope having contact of the second order with every curve of the primitive, are that the values of y and p regarded as functions of x for the envelope, should satisfy:

$$\phi = 0; \frac{\partial \phi}{\partial p} = 0; \frac{\partial \phi}{\partial x} = 0; \frac{\partial \phi}{\partial y} = 0; \frac{\partial^2 \phi}{\partial p^2} = 0.$$

The method of proof is based on Hamburg's discussion of the nature of the factors of the p-discriminant (*Crelle's Journal* Bd. 112). This theorem furnishes an important exception to the statement of Painleve (*Ency. Der. Math. Wiss.* II. A. 4a, § 22) 'If the p-discriminant of a differential equation $\phi(x, y, p) = 0$ admits of a factor, the values of y and p derived from which satisfy the differential equation as well as the equations

$$\frac{\partial \phi}{\partial x} = 0; \frac{\partial \phi}{\partial y} = 0; \frac{\partial \phi}{\partial p} = 0,$$

then that factor represents a particular integral of the given equation.'

(18) ———— *Behaviour of the lines of curvature and the asymptotic lines in the neighbourhood of a surface-point with a cubical indicatrix.*

It was pointed out in *J.I.M.S.*, Vol. 18, p. 193, that at a cubical point on a surface, the fundamental magnitudes L, M, N, of the second order all vanish. At such a point the differential equation of the asymptotic lines and the lines of curvature become illusory. The paper discusses the form of these equations in the immediate vicinity of the cubical point.

(19) S. P. RANGANATHACHAR (Bangalore). *A proof of Hardy's Theorem.*

A new proof is obtained of the theorem that if $k > 1$ and $\sum a_n^k$ is convergent, then

$$\sum \left(\frac{S_n}{n}\right)^k \text{ and } \sum a_n \left(\frac{S_n}{n}\right)^{k-1}$$

are both convergent, where

$$S_n = a_1 + a_2 + \ldots + a_n.$$

(20) M. N. NARASIMHA IYENGAR (Bangalore). *On the order of the expression* $(1^1\ 2^2\ 3^3 \ldots n^n)$.

From a consideration of the graph of $y = x \log x$, it is proved that Lt u_n is finite, where

$$u_n = \frac{1^1\ 2^2 \ldots n^n}{n^{an^2 + bn + c} \cdot e^{-(a' n^2 + b'n)}}$$

a, b, c, a', b' being so chosen that $\frac{u_n}{u_{n+1}}$ is monotonic and tends to 1.

(21) A. A. KRISHNASWAMI AIYENGAR (Mysore). *The Bakshali Manuscript.*

The questions raised by G. R. Kaye in his Government of India Archæological Memoir on the Bakshali Manuscript are discussed here.

(22) ——— *Conditions for co-normal triads and tetrads on the conic.*

This paper furnishes a simple derivation of the results of Dr. Vaidyanathaswamy on conormal tetrads (*J. I. M. S.*, Vol. 18, No 12), and points out that all the sets of necessary and sufficient conditions for a pedal triad are implicitly contained in Burnside's condition. The coaxal type of Dr. Vaidyanathaswamy and J. Wolstenholme (*Math. Problems* p. 169 Q. 1050) involves an additional relation $\sum \cos(\beta + \gamma) =$ constant.

The condition that ABC be a conormal triad on a rectangular hyperbola may be put into the form that the third pedal line through the centre (the other two being the asymptotes) passes through the centroid of the pedal triangle of ABC.

(23) ——— : *Oriented circles.*

In this paper some duals to point-theorems are studied by synthetic methods depending on Laguerre inversion. Special use is made of the inversion which carries proper oriented circles into non-linear null-circles.

(24) M. R. DORAISWAMY AIYANGAR (Mysore): *Taxation as an instrument for modifying distribution.*

Of the three agents for bettering the distribution of economic welfare — employer, society and the state — prominence has in recent times been duly given to the role of the last. It may be desired to assess precisely the extent to which the State, as 'an authoritarian element' interferes in the economic life of a nation by some stated measure of taxation. Enunciated mathematical form,, the question is: "If D is the divergence of actual econ-

omic welfare from the ideal welfare associated with a given distribution of incomes, and D′ is the similar divergence likely to arise when an income X is altered into an income X′ as a result of governmental taxation only, what value does the ratio D/D′ assume?" A numerical estimate of this ratio, which may briefly be described as a measure of governmental intervention, is obtained subject to certain limitations and assumptions. The implications of this result are also discussed with a view to show how such an estimate is serviceable in judging the probable results of any contemplated socialist legislation.

(25) M. V. JAMBUNATHAN (Mysore): *The curve of population.*

An attempt is made to derive the equation to the curve of population from an *a priori* consideration of the nature and limitations of the rate of growth of population. The equation arrived at is

$$y = \frac{M}{1 + e^{a_0 + a_1 x}},$$

y being the population at time x, M the maximum or optimum population, and a_0, a_1 constants. Methods of calculating M, a_0, a_1 are discussed.

(26) V. THIRUVENKATACHARI (Anantapur): *On some properties of the Zeta-function.*

(27) HANSRAJ GUPTA (Hoshiarpur): *On numbers in medial progression.*

A medial progression is one in which each term is the sum of the preceding two.

(28) ———: *A case for the uniformity of scale in Graphs.*

(29) G. A. SRINIVASAN, (Madras): *Classification in Mathematics.*

In view of the need for a satisfactory scheme of classification of Mathematical literature in University and College Libraries, in order that their resources may be exploited more thoroughly by students and research workers, the author considers the schemes of classification that obtain in several Libraries. A study of the merits and demerits of these systems discloses several advantages possessed by the 'Colon' scheme of classification of the Madras University Library, in respect of elasticity and mnemonic value of notation, the expansiveness of the classes and the use of multiplicity of characteristics without cross classification.

The author makes a strong plea for the adoption of this system in Indian Libraries.

(30) S. AUDINARAYANAN (Madras): ***Metrical Character of four points on a Norm Curve.***

In ordinary space, given four non-intersecting lines p. q, r, s, the conditions that they may touch a quadric and a twisted cubic are

$$\alpha^{\frac{1}{2}} + \beta^{\frac{1}{2}} + \gamma^{\frac{1}{2}} = 0$$

and

$$\alpha^{\frac{1}{4}} + \beta^{\frac{1}{4}} + \gamma^{\frac{1}{4}} = 0,$$

respectively where

$$\alpha = (pq)(rs)$$

$$\beta = (pr)(qs)$$

$$\gamma = (ps)(qr),$$

and (pq) is the mutual moment of the two lines

The case of the cubic is extended to a $(2t+1)$ space and it is found that four osculating t-folds p, q, r, s, at four points of norm curve satisfy the condition

$$\Sigma\, \alpha^{\frac{1}{(t+1)^2}} = 0.$$

Prof. Turnbull has asked the implication of

$$\alpha^{1/n} + \beta^{1/n} + \gamma^{1/n} = 0$$

In this paper I am considering the case of four points on a norm curve in n-space, and the lineo-linear invariants of the different osculating t-folds at these points for various values of t, and find that the case of $(2r+1)$-space is but a special case of the above.

(31) N DURAIRAJAN: *On a problem in the Geometry of the triangle.*

Mathematics in Indian Universities

(Abstract of a lecture delivered by Dr. A. Weil at the Conference on the 4th of April 1931.)

1. Improvements in the mathematical teaching in Indian Universities depend largely upon general improvements in the educational system in India. Mathematicians should devote themselves to the task of making such improvements as lie within their power at present, and thus contributing their share towards general reforms, which in turn will enable them to make further progress.

2. No satisfactory results can be achieved unless reforms are made both in school-teaching (including the so-called Intermediate courses) and in University teaching. So far as school-teaching is concerned, the efforts of mathematicians in the country should be mainly directed towards necessary changes in the curricula and towards the training of better teachers.

3. University teaching in mathematics should : (1) answer the requirements of all those who need mathematics for practical purposes ; (2) train specialists in the subject ; (3) give to all students that intellectual and moral training which any University, worthy of the name, has the duty to impart.

These objects are not contradictory but complementary to one another. Thus, a training for practical purposes can be made to play the same part in mathematics as experiments play in physics or chemistry Thus, again, personal and independent thinking cannot be encouraged without at the same time fostering the spirit of research.

4. The study of mathematics, as well as of any other science, consists in the acquisition of useful reflexes and in that of independent habits of thought. The acquisition of useful reflexes should never be separated from the perception of their usefulness.

It follows that problem-solving should never be practised for its own sake ; and particularly tricky problems must be excluded altogether. The purpose of problems is twofold: either to drill the student in the application of some method of special importance, or to develop his originality by guiding him

along some new path. Drill is essentially a School-method, and ought to become unnecessary at the final stages of University teaching.

5. Rigour is to the mathematician what morality is to man. It does not consist in proving everything, but in maintaining a sharp distinction between what is assumed and what is proved, and in endeavouring to assume as little as possible at every stage.

The student should therefore be gradually accustomed, by means of startling examples, to question the truth of every unproved proposition, until at last he is able to deduce from the ordinary axioms everything that he has learnt

6. Knowledge of a proof means the understanding of its machinery and the ability to reconstruct it. This implies: (1) perfect correctness in the definitions; (2) a faculty of connecting a given question with the general ideas underlying it; (3) a perception of the logical nature of any proof.

The teacher should, therefore always follow not the quickest nor even the most elegant method, but the method which is related to the most general principles He should also point out everywhere the relation between the various elements of the hypothesis and the conclusion; students must be accustomed to draw a sharp distinction between premises and conclusion, between necessary and sufficient conditions, between a theorem and its converse.

7. The teaching of mathematics must be a source of intellectual excitement. This can be achieved at the higher stages, by taking the student to the brink of the unknown; at earlier stages, by making him solve for himself questions of theoretical or practical importance.

This is the method followed in the "seminars" of the German Universities first organized by Jacobi a century ago, and even now the most prominent feature of the German system; division of labour between students in the study of a given group of questions is a common practice in these seminars, and proves to be a powerful incentive to work.

8. Theoretical lectures should neither be a reproduction of, nor a comment upon, any text-book, however satisfactory. The student's note book should be his principal text-book.

In fact, taking down notes intelligently (not under dictation) and working them out carefully at home should be considered as an essential part of the student's work; and experience shows that it is not the least useful part of it.

9. The right of any topic to form part of any curriculum is to be tested according to (1) its importance for modern mathematics or for the applications of mathematics to modern science or technique ; (2) its relations with other branches of the curriculum ; (3) the intrinsic difficulty of the ideas underlying it.

This involves a revision of the present curriculum. For instance, the idea of function, the process of differentiation and integration should appear at an early stage, because of their enormous importance both for the theory and for the most ordinary practice. Because of its practical importance numerical calculation, and all the devices connected with it, may well claim as prominent a place in an elementary course as statics and dynamics do at present.

The lecture was followed by a discussion in which the following gentlemen participated :—

Rao Bahadur P. V. Seshu Iyer, Dr. G. S. Mahajani, Dr. R. Vaidyanathaswami, Messrs. K. S. K. Iyengar, A. G. Warriar, A. Narasinga Rao, T. Totadri Iyengar, and K. S. Patrachariar.

Proceedings of the Business Meeting of the Society

(Held at 3-20 p.m. on Sunday, the 5th April 1931.)

Resolutions Passed :

1. "The members of the Indian Mathematical Society assembled at the Seventh Conference at Trivandrum offer their congratulations to Sir C. V. Raman, Honorary Member of the Society, on his being awarded the Nobel Prize in Physics for 1930."

Moved by the President and carried unanimously.

2. Dr. Mahajani moved:

"That members of the Reception Committee be treated as delegates to the Conference, and that the Reception Committee may enrol students and others as members of the Conference for the session on payment of a fee of not less than Rs. 2, and that such members be supplied with a free copy each, of the Conference Supplement."

Carried unanimously.

3. Dr. R. Vaidyanathaswamy moved:

"That the members of the Indian Mathematical Society assembled at this Conference feel that it is highly desirable for the further progress of mathematics in India that a Committee consisting of representatives from all the Indian Universities and the Mathematical Societies in India be constituted to report on the present conditions of mathematical teaching in Indian Universities and to make definite recommendations regarding the lines of improvement, and that R. Littlehailes, Esq., M.A., Educational Commissioner, Delhi, be requested to be its President, and request the Committee of the Society to take early steps to that end."

The proposition was passed in the following amended form — "That in the opinion of the Society it is necessary to enquire into the present state of Mathematical Teaching in Indian Universities and that it be a recommendation to the Committee of the Society to take immediate steps to institute such an enquiry."

4. Dr. Weil moved that :

"This meeting is of opinion that, for the time being, the Conferences of the Indian Mathematical Society should be continued as hitherto. It also expresses its readiness to co-operate fully with the Indian Science Congress in any suitable form and recommends to the Committee of the Society to reconsider the whole question after the Science Congress institutes a separate section for Mathematics."

Carried unanimously.

5. "That a Journal Committee consisting of Dr. R. Vaidyanathaswamy (Convener), Mr. A. Narasinga Rao, Dr. G. S. Mahajani, Dr. Weil and Mr. V. Ramaswami Aiyar be appointed to report on the feasibility of issuing the two parts of the Journal separately under different titles—Part I as a Quarterly ; Part II as a Monthly or so."

Moved by the President and carried unanimously.

6. "That the above Committee be also requested to report on the suggestion to print a "*Silver Jubilee Number of the Journal*," in commemoration of the Silver Jubilee of the Society next year."

Moved by the President and carried unanimously.

Dr. A. Weil on behalf of the Aligarh University invited the Society to hold its next Conference at Aligarh.

He also suggested that the Society should try and arrange for getting eminent Professors from abroad to deliver lectures on special subjects, the expenses being shared by the different Universities which join the movement.

The President's Concluding Speech.

The Seventh Conference of our Society has had a very successful session—thanks to the kindness and hospitality of the Government of Her Highness the Maharani Regent and the Reception Committee.

It was feared at one time that owing to the extreme season fixed for the meeting and the geographical situation of the place of meeting, many delegates might not congregate. The attendance, however, has been phenomenal, in spite of the above disadvantages, and in spite of the fact that most Universities and Governments which usually sanctioned deputations to our Conferences on previous occasions denied similar privileges this time on account of financial stringency.

The number of papers contributed to the Conference was thirty-one. Some of them were discussed by members with keen interest and all were of a high standard.

Two public lectures were arranged for in connection with the Conference and they were well attended.

As usual, the proceedings of the Conference will be issued separately as a "*Special Conference Supplement*," in the form of a booklet.

In conclusion, on behalf of our Society, I tender our most warm thanks to all concerned for the pleasant and happy memories associated with this Seventh Session.

The Travancore Government have treated the Indian Mathematical Society with extreme consideration. Their liberal grant, supplemented by other receipts, has made it possible for the Reception Committee to entertain the delegates on a grand scale. They have treated the President of the Society as a State Guest, which is a unique honour shown to the Society.

The Reception Committee has to be thanked for the excellent arrangements made for the comforts of the guests, the nice programme of excursions and visits, and the exquisite '*At Home*' at the Women's College.

We have to thank the Principal and Staff of the Science College for kindly taking us round the beautiful College Building and the various Laboratories, and also the Headmaster of the S. M. V. School for a similar courtesy.

Our special thanks are due to the *Local Working Committee* and their staff for the indefatigable zeal with which they have worked during all these days, sacrificing personal comforts and health.

We have to thank particularly the Dewan for opening the Conference and for inviting us to the *Pantomime Show* at his residence last night, which was an interesting specimen of the art of expressing one's emotions and thoughts by movements of limbs and facial action.

And, finally, we offer our most respectful and grateful thanks to Her Highness the Maharani Regent for the Message of Welcome graciously sent to the Conference.

Gentlemen, we carry with us happy memories of our visit to your Land of Beauties and Gardens.

With three Cheers to H. H. the Maharani Regent and H. H. the Maharaja of Travancore and also Cheers to the Dewan, the meeting terminated.

Members of the Reception Committee.

1 Mr. E. G. McAlpine, M.A., Director of Public Instruction.

2 Miss D. H. Watts, B.A.,
Retired Lady Principal, Nanthancode.

3 Rao Bahadur K. Narayanan Pandalay, B.A., B.L.,
Palace Sarvadhy Kariakar.

4 Mr. R. Venkatarama Dikshitar, B.A., B.E.,
Devaswam Commissioner.

5 „ I. C. Chacko, B. Sc., B.A., A.R.C.S.,
Director of Industries.

6 „ K. Raman Thampi, B.A., M.D.,
Inspecting Medical Officer.

7 „ J. S. Westerdale, B.Sc., Chief Engineer.

8 „ E. Sivaraman Nair, B.A., B.E.,
Personal Assistant to the Chief Engineer.

9 „ V. Arunachalam Iyer, B.A., B.E., Executive Engineer.

10 „ M. P. Mani, B.A., B.E., Executive Engineer.

11 „ C. Balakrishna Rao, B.A., B.E., Executive Engineer.

12 „ M. S. Doraiswami Iyengar, B.A., B.E.,
Maramat Engineer.

13 „ K. P. Padmanabha Menon, B.A., B.Sc. (London),
Electrical Engineer.

14 „ R. Dhanukoti Pillai, B.A. (Oxon.),
Conservator of Forests.

15 „ C. V. Chandrasekharan, M.A.,
Principal, Science College.

16 „ K. L. Moudgill, M.A., D. Sc.,
Professor of Chemistry, Science College.

17 „ C. V. Subbarama Iyer, M.A., Science College.

18 „ U. Sivaraman Nair, M.A. do.

19 Mr. S. Thanu Iyer, M.A. Science College.
20 „ P. Krishnan Namboodiripad, M.A., do.
21 „ P. Harihara Iyer, M.A. do.
22 „ E. K. Zacharias, M.A. do.
23 „ R. Sundaram Iyer, B.A., L.T., Model School, Trivandrum.
24 „ K. Sundaram Iyer, M.A., L.T. do.
25 „ N. Kuppuswami Iyengar, M.A., L.T., Training College.
26 „ P. G. Sadasivan, M.A., L.T. do.
27 „ H. Subramoni Iyer, M.A., Ph.D., Women's College.
28 „ K. G. Sesha Iyer, B.A., B.L., Thycaud.
29 „ E. Subramoni Iyer, M.A., M.L., Trivandrum.
30 „ A. Narayana Iyer, B.A., L.T., Thycaud.
31 „ U. Ramakrishna Kukkilaya, B.A., L.T., Retired Inspector of Schools.
32 „ L. Anantakrishna Iyer, B.A., L.T., Inspector of Schools (English).
33 „ S. Sesha Iyer, B.A., B.E., Assistant Engineer.
34 „ K. C. Thomas, B.A., B.E., Assistant Engineer.
35 „ R. Srinivasan, M.A., Professor of Mathematics, Science College.
36 Dr. Mary Poonnen Lukose, Trivandrum.
37 Miss F. E. Grose, M.A., Principal, Women's College.
38 „ K. C. Annamma, M.A., Women's College.
39 „ R. Gnanaprakasi, M.A., do.
40 Mr. R. Ranga Iyer, B.A., L.T., Personal Assistant to the D. P. I.
41 „ S. Venkataraman, Palamcottah.
42 „ P. A. Subramoni Iyer, B.A., L.T., C. M. S. College, Kottayam.

43 Mr. K. P. Krishna Menon, B.A., L.T.,
Headmaster, N. S. High School, Mannar.

44 „ C. P. Subramoni Iyer, M.A., L.T.,
Headmaster, Alleppey.

45 „ G. R. Narayana Iyer, M.A., L.T.,
Maharajah's College, Ernakulam.

46 „ R. Krishnaswami Iyer, B.A.,
Retired Principal, Parur.

47 „ C. K. Thomas, M.A.,
Principal, C.M.S. College, Kottayam.

48 „ A. M. Varki, M.A., B.L.,
Principal, Union College, Alwaye,

49 „ Rev. J. Palocaran, M.A.,
Principal, St. Thomas College, Trichur.

50 „ R. Sivaramakrishna Iyer, B.A., L.T.,
Headmaster, Quilon.

51 „ T. S. Venkataraman, M.A.,
Math. Lecturer, Union Christian College, Alwaye.

52 „ T. A. Sadagopan, M.A., L.T.,
St. Berchman's College, Changanachery.

53 „ T. S. Pitchu Iyengar, B.A., L.T.,
Headmaster, Government High School, Mavelikara.

54 „ John K. Jacob, B.A., L.T., High School, Mavelikara.

55 „ V. Narayana Kamath, B.A., L.T.,
Headmaster, English High School, Thuravoor.

56 „ T. T. Abraham, B.A., L.T.,
English Middle School, Ettumanoor.

57 Rao Bahadur P. V. Seshu Iyer, B.A., L.T.,
Principal, Hindu College, Tinnevelly.

Donations and Subscriptions.

		RS.	A.	P.
Travancore Government	...	491	3	8
Indian Mathematical Society	...	100	0	0
Mr. E. Subramoni Iyer	...	125	0	0
„ E. G. McAlpine	...	75	0	0
„ J. S. Westerdale	...	25	0	0
„ R. Srinivasan	...	25	0	0
Miss F. E. Grose	...	15	0	0
Mr. C. V. Subbarama Iyer	...	15	0	0
Dr. H. Subramoni Iyer	...	15	0	0
Mr. P. V. Seshu Iyer	...	10	0	0
Miss K. C. Annamma	...	10	0	0
Mr. M. S. Doraiswami Iyengar	...	10	0	0
„ U. Sivaraman Nair	...	10	0	0
„ R. Venkatarama Dikshitar	...	10	0	0
„ V. Arunachalam Iyer	...	10	0	0
Miss R. Gnanaprakasi	...	7	0	0
Dr. Mary Poonnen Lukose	...	7	0	0
Mr. K. Narayanan Pandalay	...	5	0	0
Miss D. H. Watts	...	5	0	0
Mr. I. C. Chacko	...	5	0	0
Dr. K. Raman Thampi	...	5	0	0
Mr. E. Sivaraman Nair	...	5	0	0
„ M. P. Mani	...	5	0	0
„ R. Dhanukoti Pillai	...	5	0	0
Dr. K. L. Moudgill	...	5	0	0
Mr. S. Thanu Iyer	...	5	0	0
„ E. K. Zacharias	...	5	0	0
„ K. P. Krishna Menon	...	5	0	0
„ C. P. Subramoni Iyer	...	5	0	0
„ R. Sundaram Iyer	...	5	0	0

	RS.	A.	P.
Mr. N. Kuppuswami Iyengar	5	0	0
„ U. Ramakrishna Kukkilaya	5	0	0
„ A. M. Varki	5	0	0
Rev. J. Palocaran	5	0	0
Mr. K. P. Padmanabha Menon	5	0	0
„ C. V. Chandrasekharan	5	0	0
„ P. A. Subramoni Iyer	5	0	0
„ C. K. Thomas	5	0	0
„ G. R. Narayana Iyer	5	0	0
„ P. G. Sadasivan	5	0	0
„ K. G. Sesha Iyer	5	0	0
„ L. Anantakrishna Iyer	5	0	0
„ S. Sesha Iyer	5	0	0
„ K. C. Thomas	5	0	0
„ R. Ranga Iyer	5	0	0
„ R. Sivaramakrishna Iyer	5	0	0
„ T. S. Pichu Iyengar	5	0	0
„ T. S. Venkataraman	5	0	0
„ T. A. Sadagopan	5	0	0
„ K. Sundaram Iyer	5	0	0
„ A. Narayana Iyer	5	0	0
„ C. Balakrishna Rao	5	0	0
„ P. Harihara Iyer	5	0	0
„ P. Krishnan Namboodiripad	5	0	0
„ John K. Jacob	5	0	0
„ R. Krishnaswami Iyer	5	0	0
„ V. S. Narayana Iyer	5	0	0
„ V. Narayana Kamath	5	0	0
„ T. T. Abraham	5	0	0
„ S. Venkataraman	5	0	0
Subscriptions under Rs. 5	47	0	0
Total	1,222	3	8

Members and Delegates who attended the Conference.

1 M. T. Naraniengar, M.A.,
President, Indian Mathematical Society.

2 V. Ramaswami Iyer, M.A.,
Retired Deputy Collector, Chittoor.

3 Dr. R. Vaidyanathaswami, M.A., D.Sc.,
Reader, Madras University.

4 Dr. Andre' Weil, Aligarh.

5 G. S. Mahajani, B.A. (Cantab),
Principal, Fergusson College, Poona.

6 K. S. K. Iyengar, B.A. (Cantab),
Central College, Bangalore.

7 A. Narasinga Rao, M.A., L.T., Annamalai University.

8 L. N. Subramania Iyer, M.A., L.T.,
Madras Christian College, Madras.

9 S. Sivasankaranarayana Pillai, M.Sc.,
Annamalai University.

10 B. Ramamoorthi, M.A., Annamalai University.

11 S. Mahadeva Iyer, M.A., L.T.,
Presidency College, Madras.

12 G. A. Srinivasan, M.A., L.T., do.

13 C. N. Srinivasa Iyengar, M.A., M.Sc.,
Central College, Bangalore.

14 M. R. Doraiswami Iyengar, M.A., M.Sc., Mysore.

15 A. A. Krishnaswami Iyengar, M.A., L.T., Mysore.

16 K. S. Patrachari, M.A., L.T.,
Engineering College, Guindy.

17 P. Krishnamachari, M A., Govt. College, Coimbatore.

18 T Totadri Iyengar, M A , St Joseph's College, Trichy.

19 S. Ramaswami Iyer, M.A , St. Thomas College. Trichur.

20 G. V. Krishnaswami, M A , Annamalai University.

21 P. S. Ganesa Sastri, M.A., L.T.,
National College, Trichy.

22 K. Subramaniam, M.A., L.T.,
Hindu College, Tinnevelly.

23 M. V. Ramakrishnan, M A., L.T., Palamcottah.

24 A. Mahadeva Iyer, M.A., Tinnevelly.

25 M. V. Arunachala Sastri, M A., L.T., Hyderabad.

26 S. Sundaram Iyer, B,A., Triplicane.

27 P. R. Subramaniam, B.A., Mysore.

28 M. S. Doraswami, M A., L.T., Villipuram.

29 S. Venkataraman, Palamcottah.

30 K. S. Rajagopalan, Guindy, Madras

31 T. Rajagopalan, B.A., Trichy.

32 Dr. K. Vedantan, Triplicane.

33 S. Adinarayanan, M A , Triplicane.

34 V. H. Mahadevan, Tinnevelly.

35 A. Akambaram, Hyderabad.

36 V. Ramakrishnan, B.A , L.T., Tinnevelly.

37 V. K. K. Sarma, Krishnancoil, Nagercoil.

38 Miss Seshu Iyer, Tinnevelly.

39 G. V. Annaswami Iyengar, Bangalore.

40 A. N. Ratnagireeswaran, M.A., Triplicane.

41 R. Venkatarama Dikshadar, B.A., B.E.,
Devaswam Commissioner, Trivandrum.

42 K. Raman Tampi, B.A., M.D.,
Inspecting Medical Officer, do.

43 B. Sivaraman Nair, B.A., B E ,
Personal Assistant to Chief Engineer, do.

44 V. Arunachalam Iyer, B.A., B.E.,
Executive Engineer, do.

45 M. S. Doraswami Iyengar, B A , B.E.,
Maramat Engineer, Trivandrum.

46 K. P. Padmanabha Menon, B.A , B.Sc.
(London), &c., Electrical Engineer. do.

47 R. Dhanukoti Pillai, B.A. (Oxon),
Conservator of Forests, do.

48 E. G. McAlpine, M A.,
Director of Public Instruction, do.

49 C. V. Chandrasekharan, M.A ,
Principal, Science College, do.

50 C. V. Subbarama Iyer, M.A., Science College, do.

51 U. Sivaraman Nair, M A., do. do.

52 S. Thanu Iyer, M A., do. do.

53 P. Krishnan Nampoodiripad, M.A., do. do.

54 P. Harihara Iyer, M.A. do. do

55 R. Sundaram Iyer, B.A., L.T.,
Model School, Trivandrum.

56 K. Sundaram Iyer, M A , L.T., do. do.

57 N. Kuppuswami Iyengar, M.A., L.T.,
Training College, do.

58 P. G. Sadasivan, M.A., L T., do. do.

59 H. Subramoni Iyer, M.A., Ph.D.,
Women's College, do.

60 E. Subramoni Iyer, M.A., M.L., do.

61 A Narayana Iyer, B A., L.T., Thycaud, Trivandrum.

62 U. Ramakrishna Kukkilaya, B.A., L.T.,
(Near Bhaktivilas) Trivandrum.

63 L. Anantakrishna Iyer, B,A., L.T.,
Inspector of English Schools, do.

64 R. Srinivasan, M.A.,
Prof. of Mathematics, Science College, do.

65 Miss K. C Annamma, M.A ,
Women's College, Trivandrum

66 Miss R. Gnanaprakasi, M.A ,
Women's College, Trivandrum.

67 R. Ranga Iyer, B.A., L T.,
Personal Assistant to the D P.I. do.

68 K. P. Krishna Menon, B.A , L.T ,
Headmaster, N. S. High School, Mannar

69 G. R. Narayana Iyer, M.A., L.T ,
Maharajah's College, Ernaculam.

70 Rao Bahadur P. V. Seshu Iyer, B A., L.T ,
Principal, Hindu College, Tinnevelly.

71 R. Sivaramakrishna Iyer, B.A , L.T ,
Headmaster, Quilon.

72 T. S. Venkataraman, M.A.,
Math. Lecturer, Union Christian College, Alwaye.

73 T. S. Pitchu Iyengar,
Headmaster, Govt. High School, Mavelikara.

74 V. Narayana Kamath, B.A., L T.,
Headmaster, Eng. High School, Thuravoor.

75 T. T. Abraham, B.A., L.T.,
English Middle School, Ettumanoor.